

Jurisdictional Scan of Retrofit Initiatives

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Executive Summary

During the course of this project, we explored three cities and compared their building retrofit plans to those of the City of Toronto to understand the key factors impacting their progress towards their retrofit goals. Vancouver, New York City, and Copenhagen were the cities we chose: Vancouver as a Canadian charter city, New York as a city with a similar climate but a considerable headstart when compared to Toronto, and Copenhagen as a city with a very progressive, green-energy focused federal government and the most aggressive carbon emissions reduction goals in the world. This research provided useful insight into what these jurisdictions have done well and the lessons we can take from their work. The key messages were the following: **allowing a jurisdiction to make their own decisions with regards to energy retrofit work** is beneficial; **funding from federal and provincial orders** is a necessity; and having **exemplary pilot projects** is imperative to demonstrating to owners and residents what is possible when retrofits are done properly.

Introduction

The City of Toronto (CoT), with support from The Atmospheric Fund (TAF), is working on an ambitious plan to reduce greenhouse gas emissions to net zero by 2040 or 2050. Buildings account for 55% of emissions in Toronto. The CoT, among many other cities, relies on technical modelling exercises, plans, and policies to project future greenhouse gas levels and develop appropriate retrofitting strategies. While critical, developing realistic adoption rates and tracking them are difficult from these models. This is due to the lack of published data and progress reports from different jurisdictions, many of which may not want to reveal that they are not on track to meeting their targets. As a result, there is some uncertainty about the reality of the CoT achieving its building retrofit goals and climate targets more broadly; best practices or lessons in overcoming barriers to retrofits are more difficult to find amongst government publications and other grey literature with the lack of published data.

TAF identified that one of the main challenges the City of Toronto faces in meeting its net zero goals is scaling deep retrofits and fuel switching to all existing residential and commercial buildings by 2050. The purpose of this jurisdictional scan is to assess progress towards retrofit targets of other municipalities, and best practices and lessons that are helping them work towards or accelerate building retrofits. Ultimately, we aim to identify whether these strategies or best practices can inform or be applied to the CoT's strategy for building retrofits.

Background

TransformTO Net Zero Strategy

The TransformTO Net Zero Strategy was released in November 2021 to outline a pathway to achieve net zero carbon emissions by 2050 or sooner (a goal of 2040 was passed in December 2021). The Strategy also presents a set of 2030 targets, including reducing city-wide emissions by 65%. Based on technical plans using the CityInSight model developed by Sustainability Solutions Group (SSG) and whatIf? Technologies Inc, it is critical that the City meets its 2030 targets to maintain a trajectory towards carbon neutrality by 2040 or 2050.

The Strategy specifically highlights the importance of reducing emissions in new and existing buildings. By 2030, the CoT aims for 100 percent of new buildings to be designed and constructed to be near zero greenhouse gas emissions and missions from existing buildings to be cut in half from 2008 levels. The Strategy also stresses the need for rapid electrification of existing buildings and the implementation of mandatory emissions performance targets to better understand and reduce emissions within existing building stock.

For clarity, the Strategy defines a deep retrofit as an upgrade package - typically involving improvements to the building envelope and fuel switching from natural gas to electricity - leading to a minimum reduction in GHG emissions by at least 50% (TransformTO Net Zero Strategy, 2021).

Net Zero Existing Buildings (ExB) Strategy

The Net Zero Existing Buildings Strategy was adopted by City Council in July 2021 to provide a pathway to decarbonization of existing buildings. The ExB Strategy was guided by technical modelling, stakeholder engagement and a review of policies and best practices related to energy and emissions reductions from other jurisdictions.

The ExB Strategy provides a breakdown of emissions in the building sector. 57% percent of city-wide emissions come from buildings, in which 60% percent comes from the residential sector, while the other 40% comes from commercial, industrial and institutional combined. The majority of emissions derive from the energy used to heat, cool and ventilate buildings as well as from plug loads. More specifically, natural gas accounts for 91% of all Toronto building emissions, and 97% of residential buildings. This highlights how fuel switching away from natural gas is all the more critical.

Models of different pathways were created to show how the building sector could reduce emissions under business-as-planned, least costly, aggressive and recommended. (Appendix A)

The ExB Strategy outlines 9 recommended actions for the City to undertake, outlining key considerations and implementation challenges associated with each action.

Table 1: Overview of Nine Recommended Actions in the ExB Strategy

Purpose	Actions
Set requirements to assess building performance and create a path to net zero	1. Require annual emissions performance reporting and public disclosure for all existing buildings 2. Establish emissions performance targets 3. Require energy and emissions audits and tune-ups
Provide support and resources to make retrofits easier and more affordable	4. Provide integrated retrofit support 5. Expand and enhance retrofit financing 6. Support permitting and approvals processes for deep retrofits
Lay the groundwork for market transformation	7. Build awareness and capacity of home and building owners for emissions reduction strategies and supports 8. Support workforce development and training 9. Advocate and partner with other levels of government

To deliver on these actions, modelling analysis estimates that \$300 billion must be co-invested from public and private actors between 2020-2050. This is \$140 billion more than the business-as-usual plan.

The ExB Strategy highlights key factors impacting adoption and scaling of retrofits, such as the regulatory environment, providing incentives to make retrofits easier and affordable, and building capacity of the workforce to perform retrofits.

Challenges Facing Toronto

Being so early in the TransformTO strategy, a lot of planning is yet to be done, particularly as work needs to be done to determine what approach will be taken towards accomplishing the goals set out in both strategies.

Data

As with the determination of the City's approach, data is very important in measuring the success of retrofits. The City does not yet have a very good concept of whether or not they are making progress, but they are trying to combat this by mandating annual emissions reporting for all commercial buildings. In 2022, they plan to receive emissions reporting for 6,000 buildings and increase that number year-over-year. Being so early in the project means that estimating aggregate emissions is difficult, so the City is using models and artificial intelligence to estimate figures to help them better understand progress. As we will see with other jurisdictions later in our report, cities are using pilot and landmark projects as examples for what is possible for the rest of the city. Buildings under the Energy and Water Reporting and Benchmarking (EWRB)

regulation have the highest compliance rate: around 1,500 buildings over 100,000 square feet have reported their emissions (City of Toronto interview).

Emissions Regulation

The City wants to mandate regulatory performance management for buildings (Actions 1-3 in the ExB Strategy), but lacks the autonomy to implement some of the actions in the strategy. With its current authority, the City should be able to implement the second two (Establish Emissions Performance Requirements; Require Energy Audits and Retro-commissioning), but the first (Require Annual Performance Reporting & Public Disclosure) does not have a concrete legal path yet. This will require an exhaustive consultation with the City's legal team. Furthermore, the Government of Ontario oversees the building code for the entire province, which means the CoT cannot change the building code on its own to advance retrofit goals. In its current state, several of our interviewees noted that the provincial building code does not align with the objectives in the TransformTO Net Zero Strategy.

So far, the City has set voluntary emissions targets in the near-term (i.e. 2022-2024), and are planning for a transition to mandatory requirements in the medium-term (i.e. 2025-2029) to long-term (i.e. 2030+). Draft temporal targets are outlined in the ExB Strategy (Section 4.1) (examples in Appendix B). To encourage action, the City announced the GreenWill Initiative in 2019, a voluntary emissions reductions initiative announced in 2019 for commercial buildings as well as hospitals and universities. So far 28 buildings have signed on, out of a potential 4500, including the City of Toronto as a building portfolio manager (City of Toronto interview).

Finances and Incentives

The City of Toronto offers a few financing programs to make retrofits more accessible, such as the City of Toronto Energy Retrofit Loan, the High-Rise Retrofit Improvement Support Program and the Home Energy Loan Program (HELP). HELP started as a pilot program and grew to be city-wide, offering up to \$125,000 with low interest rates, even close to zero percent. Take up of HELP has not been as high as expected - it has been difficult to get banks on board due to low interest rates and due to the fact that the loan is tied to the property rather than the individual (interview with Toronto City Councillor). Even with low interest rates, others are hesitant to take on more debt with rising housing unaffordability across the city.

Incentive programs exist as well, but are not led by the City of Toronto. Some are linked to energy companies to reduce energy costs such as the Enbridge Gas Home Efficiency Rebate. Others include small grants, such as the one administered by Natural Resources Canada, Canada Greener Homes Grant, which covers up to \$5000 in upgrades to insulation, space and water heating, air-sealing and more. Projects can be more costly than \$5000 however, depending on the

region and what is being retrofitted. As such, grants that cover a larger portion of costs need to be explored.

Another set of challenges surround workforce development for retrofits. With increasing demand from the building sector for retrofits, the labour market has yet to catch up; there are not a sufficient number of contractors and service providers to install heat pumps for example. The pandemic has led to several hiring freezes, challenges in retrofitting buildings with lockdowns and disruptions to supply chains. The City also acknowledges that it has not developed toolkits and guides to train building owners on the process for retrofits and how to deal with replacing items like HVAC systems.

Methodology for Assessment Criteria and Jurisdictional Choices

Our research methodology to build this jurisdictional scan comprised three phases. The first consisted of reading through the TransformTO Strategy, NetZero Existing Building Strategy and associated modelling documents to obtain the City's retrofit targets and identify any key factors impacting the adoption and scaling of retrofits. This review of government documents was coupled with a review of grey literature to understand the impediments and lessons related to building retrofits in North America primarily.

With a concrete understanding of the key factors impacting the adoption of retrofits in Toronto and elsewhere, the second phase consisted of writing a pilot jurisdictional scan of two other municipalities - Vancouver and New York City - to attain a deeper understanding of their climate models and policies for building retrofits. This exercise helped our team assess the feasibility of finding data and metrics related to the progress of municipalities in achieving their retrofit goals, and whether the key adoption factors identified at the end of phase 1 were relevant to other jurisdictions. While working on the pilot, we also interviewed five individuals with experience in the buildings and retrofit sector from Toronto, Vancouver and New York City. Through these interviews, we were able to ask questions related to adoption rates, challenges and finances that could not be found through online research. We were also able to confirm that the key factors impacting the adoption and scaling of retrofits identified at the end of phase 1 were indeed the most relevant for Toronto and other cities included in the pilot and final jurisdictional scans. Since we did not obtain explicit consent, we have kept their names confidential when referencing their insights throughout the report.

Guided by our research and interview findings, this jurisdictional scan narrows down on a set of evaluation criteria to ensure we are addressing the most important goals and factors related to scaling retrofits.

While there are several goals outlined in the TransformTO Strategy, we focus on 3 key targets related to retrofits and fuel switching to compare with in other jurisdictions:

- Retrofit 100% of existing buildings by 2050 (this averages to ~29,000 residential and ~400 commercial buildings per year).
- Convert 100% of residential and non-residential building water and space heating to heat pumps.
- Phase out residential natural gas appliances by 2050.

The key factors impacting the goals above that we will primarily investigate are:

- Regulation
- Finances
- Incentives
- Workforce development

Finally, the selection of our three jurisdictions - Vancouver, New York City and Copenhagen - follows the methodology from our pilot jurisdictional scan. We started with municipalities referenced in the CoT documents, and researched whether these cities operated within a similar regulatory environment to Toronto. This left us with municipalities in Canada and North America to examine. We narrowed down our selection based on municipalities that launched retrofit building plans prior to Toronto with clear targets and who were known for their innovative approaches to retrofits. We also took into account other factors such as whether these municipalities had similar cold climates and building stock to Toronto. This resulted in Vancouver and New York being the jurisdictions for our pilot jurisdictional scan and included in the final one. After completing the pilot, we also decided to include Copenhagen due to its worldwide recognition for sustainability and building retrofits, enabling us to think about what aspirational environment is needed for Toronto to be successful in its retrofit goals.

Jurisdictional Scan

Vancouver

Background:

As a fellow Canadian city that is working towards having all new buildings be zero-emissions by 2030, the CoT stands to learn from what Vancouver shares with Toronto. These similarities are offset by a regulatory context that sets Vancouver apart from most other jurisdictions, changing the scope with which it is possible for the CoT to apply Vancouver's methods.

Provincial and municipal regulations unique to Vancouver have eased the retrofitting process. Renewable electricity mandates in British Columbia (B.C.) have nearly eliminated its GHG emissions from electricity use, leaving Vancouver to primarily retrofit heating systems reliant on fossil fuel. The jurisdiction's efforts through multiple ministries to reduce emissions from

heating systems offer notable potential for this city, and for Toronto as it builds retrofits suited for its own local climate.

Regulation:

In November 2020, the City of Vancouver released its *Zero Emissions Building Retrofit Strategy* to describe a clear path to zero carbon emissions in new and existing buildings. There are four main actions needed to achieve the target of zero carbon emissions by 2050 (City of Vancouver, 2020). These actions include: set carbon pollution limits and streamline regulations, support early owner action, build industry capacity and facilitate access to renewable energy (City of Vancouver, 2020). The construction of new buildings with low emission technology has found more success via these regulations, rather than retrofitting existing ones. In an interview, a representative from Vancouver's Zero Emissions Building Plan discussed the value of the city's regulatory efficiency. This structure has assisted this jurisdiction in scaling up this new construction, making future performance outcomes for construction projects clear and providing the necessary guidance to reach those outcomes with partners.

To ensure that excessive pressure is not placed on building owners and residents, the City of Vancouver has adopted a phasing approach by setting carbon pollution limits which will be required for most buildings (City of Vancouver, 2020). Initial carbon limits will be placed on the worst performing 10-20% of buildings and homes where upgrades are low-cost and will provide energy savings and benefits (City of Vancouver, 2020). More significant carbon limit requirements will be set by 2030 which will signal new investments in high-efficiency renewable energy heating and hot water equipment as necessary.

This strategy sets out carbon limits for commercial buildings, multi-family buildings and detached homes. Commercial buildings represent about 26% of building sector carbon pollution. This strategy recommends annual carbon pollution limits (kg CO₂e/m²) for large office and retail buildings with more than 10,000 m² (~100,000 ft²) of floor space starting in 2025 (City of Vancouver, 2020). Large buildings will be subject to carbon pollution intensity limits (kg CO₂e/m² /year) that decrease over time (City of Vancouver, 2020). Both smaller floor areas and large buildings will be subject to prescriptive equipment requirements that will be identified and put in place before 2030.

Multi-family homes represent about 24% of building sector carbon pollution. This strategy recommends that no carbon pollution limit should be placed for rental buildings and non-market housing (City of Vancouver, 2020). There should be a focus on providing incentives and support for voluntary retrofits. Large condominiums require a benchmark reporting by 2023 for buildings more than 5,000 m², carbon pollution limits starting in 2030 for buildings more than 10,000 m² (City of Vancouver, 2020).

Detached homes represent about 28% of building sector carbon pollution. The Strategy recommends annual carbon pollution limits (tonnes CO₂) for detached homes starting in 2025 (City of Vancouver, 2020). The carbon limits for low-rise residential homes will be set on an absolute basis (tonnes CO₂e/year). These will typically require large homes to make more substantial and earlier upgrades, and will be easier to meet in smaller homes (City of Vancouver, 2020). Homes that use electricity for space and water heating, as is common for laneway houses, are already nearly zero emissions.

Finances:

In December 2018, the B.C. government released its new climate plan, CleanBC, which includes \$58 million for building energy retrofits in addition to the previously announced \$1.1B for capital renewal of non-market housing over 10 years. In addition to an investment of \$1.01 billion by the federal government to increase energy efficiency in residential, commercial and multi-unit buildings.

The City of Vancouver participates in multiple pilot retrofit programs for multi-family buildings, and has detailed the funding behind them. For those programs where budgetary information is available, Vancouver has partnered with supporters who partially fund the retrofit programs alongside municipal funding. These include the Rental Apartment Energy Retrofit Plus Reinvestment Program, for which the City of Vancouver has supplied half of the funding. The municipal government has partnered with its provincial government and LandlordBC for a \$3 million program to support the installation of envelope retrofits and heat pumps (General Manager of Planning, Urban Design and Sustainability and General Manager of Engineering Services, 2020).

Another collaboration between the City of Vancouver and retrofitting partners is shown through the FortisBC Deep Retrofit Pilot Project, estimated at a \$10 million budget. The municipal government collaborates with more partners on this project, partnering with FortisBC, BC Housing, BC Non-Profit Housing Association, and the Pendrellis Society to provide retrofits for a senior's non-market housing building (General Manager of Planning, Urban Design and Sustainability and General Manager of Engineering Services, 2020).

Incentive Programs:

A critical aspect of encouraging building owners to retrofit new and existing buildings is providing incentives for heat pumps and supporting efficiency measures that reduce energy demand. Heat pumps are a key technology in reducing carbon pollution and currently have a very low market share in British Columbia.

Commercial Buildings

Currently, CleanBC (the provincial government and BC Hydro) offers energy and capital funding incentives through its Custom and Custom-Lite programs for large and small commercial buildings (CleanBC, 2019). These programs are accessible to a few of the largest commercial and institutional building owners (CleanBC, 2019). This program has not been able to attract many commercial building owners as its current requirements make it a barrier for smaller building owners to participate.

Multi-Family Buildings

CleanBC offers the Custom-Lite program which provides incentives to condos and market rental building owners with incentives for small commercial buildings (CleanBC, 2019). There has been very little uptake of this program because the requirement for energy study and the funding level for heat pumps is minimal (City of Vancouver, 2020). There is a requirement for the development of an easy-to-access incentive program through CleanBC to all multi-family buildings (City of Vancouver, 2020). This should include centralised equipment such as heat pumps and decentralised equipment such as ductless mini-splits.

Envelope repair and replacement in condominiums is common in Vancouver but this incentive has not been taken advantage of to significantly improve the energy performance of the building (City of Vancouver, 2020). Replacement of windows in multi-family buildings rarely occurs due to the high costs. There are no envelope or window incentive programs currently available for multi-family buildings (City of Vancouver, 2020).

Detached Homes

The City of Vancouver provides a pool of funding to top-up the province-wide CleanBC rebates for envelope upgrades, heat pumps for heating and hot water equipment and electrical panel upgrades (CleanBC, 2019). Higher dollar-value top-ups are given for higher-performance equipment and fuel-switching projects such as switching from a gas furnace to an electric heat pump (Appendix C).

The Vancouver Heritage Foundation

The Vancouver Heritage Foundation has offered the Home Energy Retrofit Grant (HERG) to drive deep energy retrofits of designated heritage buildings (Vancouver Heritage Foundation, 2022). The City of Vancouver is an active funding partner of this foundation. A maximum of \$10,000 per home is available toward qualifying retrofits or a maximum of \$14,000 if the home is fuel-switching from gas or oil to electric air-source heat pumps (Vancouver Heritage Foundation, 2022).

Workforce Development:

The City of Vancouver will work with industry partners to develop a roadmap to address barriers and capitalise on opportunities regarding skills and training. Funding is to be provided for the creation of resource guides and training opportunities to identify knowledge and skills gaps (City of Vancouver, 2016). The development of these materials is through partnerships with organisations such as the homeowner Protection Office, B.C. Hydro and the Architects Institute of B.C. (City of Vancouver, 2016). For example, the B.C. Construction Association has indicated that resources aimed at improving procurement practices would lead to more innovation (City of Vancouver, 2016).

New York City

Background:

Since buildings contribute roughly 75% to the city's total emissions, the City first launched *One City, Built to Last: Transforming New York City's Buildings for a Low-Carbon Future* in 2014, a comprehensive plan to retrofit both public and private buildings. The plan outlines goals requiring buildings over 25,000 square feet to measure and disclose their annual energy use, conduct energy assessments and upgrade their lighting. The full range of programs and policies in the plan are expected to cut GHG emissions by nearly 3.4 million metric tons by 2025, save New Yorkers nearly \$1.4 billion annually on utility bills, and create nearly 4000 jobs in construction as well as upskilling nearly 8000 workers. The goals from the plan, and progress to date are reported in Appendix G.

While New York City is further along in its retrofitting journey than Toronto, they are still quite early in the process. With the end-goal being an 80% emissions reduction by 2050 and the program having begun in 2014, they are only eight years into a 36-year project (City of New York, 2015).

Regulation:

In December 2009, City Council signed into law the Greener, Greater Buildings Plan (GGBP), which comprises four laws to address energy efficiency in existing buildings. It mandated benchmarking for large buildings and included plans to finance energy retrofits and help upskill workers to implement the GGBP. The Plan also led to the creation of the New York City Energy Code (Local Law 85 2009), which gave authority to the City to create new energy standards for buildings. This includes mandating minor renovations (which includes retrofits) that were previously exempted to meet the New York State energy code. In early 2020, a new Energy Conservation Code was created to hold construction and renovations to existing buildings under stricter standards (City of New York, *Energy*). Buildings are required to have better thermal

envelopes that will be tested for control of air leakages and meet minimum energy efficiency requirements for heating and cooling systems, among many other standards.

Since enforcing annual performance measurement from buildings; more than 2.1 billion square footage of buildings have been benchmarked since 2010. Through analysis of the initial data, the City found that multifamily residential buildings have the greatest potential for energy savings. With enforced building performance and publicly disclosed data, the City has been able to take stock of actual progress, enact more laws around building codes and water, energy and fuel use, tailor programs to multifamily residential buildings, and encourage building managers to speed up retrofits. It is worth noting that buildings are not anonymized, unlike in Ontario, which enables greater accountability for buildings to perform better.

In 2011, NYC regulated the phasing out of the two most polluting fossil fuels for heating in approximately 10,000 buildings: No. 6 heavy heating oil by 2015 and No. 4 fuel oil by 2030. To accompany the transition, the City created the Clean Heat Program. Between 2012 and 2015, nearly 6000 buildings converted to cleaner fuels, with 1500 conversions alone in 2014. Despite strong compliance, it took until 2019 for the City to completely phase out No. 6 oil. After 2030, only ultra-low sulphur oil (#2), biodiesel and natural gas can be used. In 2020, Mayor Blasio announced the City would try to phase out natural gas and heating oil in buildings by 2040, which includes a ban on natural gas hookups for new buildings starting in 2023. This is part of the City's broader 2040 goal to switch from fossil fuel dependency to an electric grid powered by zero-emission resources (Mayor Office of Sustainability, n.d.).

Local Law 97, signed in 2019, is an aggressive regulation that subjects owners of structures of over 25,000 square feet to substantial fines if they do not meet new energy efficiency and greenhouse gas emissions limits by 2024 (*Local law 97*, NYC Sustainable Buildings). The law affects 50,000 of the city's one million buildings. The new emission limits are in Appendix C.

Finances:

An exact estimate of the total finances required to achieve NYC's retrofit targets could not be found online or through interviews. However, the Built to Last Plan lists a few institutions providing financing options, including ones for multifamily buildings (Appendix D). One institution mentioned is NYC Energy Efficiency Corporation (NYCEEC), the country's first green bank. It provides loan products for renovations and construction, such as deep energy retrofits for various building typologies - multifamily units, affordable housing units, commercial buildings and more. NYCEEC also administers the City's version of the nation-wide Property Assessment Clean Energy (PACE) loan, in which repayments to the loan are done through instalments to the property tax bill, which is preferred for many property owners.

The City also runs the Green Housing Preservation Program (GHPP), which provides low- or no-interest financing for energy efficiency and water conservation improvements, lead remediation, and moderate rehabilitation work. The program targets small- and mid-size building owners with a focus on multi-family buildings under 50,000 square feet. Loans range from \$50 - 80,000 USD per unit depending on the scope of the work.

With many financing options available, the NYC Accelerator (which is explained further below) acts as a one-stop-shop for much of this information, providing customised support to private large building owners. Toronto should consider a one-stop shop for financing options that owners can come to for support.

Incentive Programs:

Multifamily buildings

Similar to Toronto, most incentives are provided by New York State through NYSERDA or private energy companies. NYSERDA, which administers over 70 programs related to energy efficiencies and retrofits, runs the Multifamily Buildings Program, which provides incentives and technical assistance for owners and managers. One example is the Low Carbon Pathway, which offers incentive packages focusing on four energy systems: building envelope, ventilation, domestic hot water, and heating and cooling. Incentives range from \$700-5000 per dwelling unit (NYSERDA, n.d.). NYSERDA also runs RetrofitNY, which is working on pilot initiatives for multifamily buildings and affordable housing units to identify key adoption factors and bring replicable retrofit plans to scale in the market (see Appendix E for more information on RetrofitNY and its pilot projects).

Another program is the NYS Clean Heat Initiative, in which NYSERDA offers screenings free of charge to assess whether a ground or air heat pump could be installed in homes, small businesses and commercial and multifamily buildings. Electric utility companies, such as Con Edison, then offer rebates if the heat pump is installed. More examples of financing and incentives for multifamily buildings are in Appendix F.

Larger buildings

With over 1.6 billion square feet of rooftops in New York City, the City offers tax abatements for buildings who install green roofs and solar panels.

The City also launched a retrofit accelerator program, NYC Accelerator, to help catalyse the retrofitting of approximately 20,000 private buildings between 2015 and 2025 (7,500 properties), comprising multifamily buildings (~60 percent) and government-assisted affordable or rent-stabilised buildings (~40 percent) (City of New York, NYC Accelerator). The program is

designed to help building owners implement water efficiency and building energy upgrades through free, individualised support for building decision-makers on how to cut operating costs, understand and meet local law compliance, boost building performance and access financing. They offer resources called High Tech Primers which introduce options of high performance technology across heating and cooling, building envelopes, plug loads and lighting. They were developed in partnership with a local organisation called The Building Energy Exchange, which connects New York City's real estate design communities with one another and offers resources and solutions for energy and lighting efficiency. These resources explain each technology, which type of building it's most suited to, steps for implementation, and the benefits and costs associated with the technology. For example, they offer 4 pamphlets on different kinds of heat pumps: one-pipe steam optimization, two-pipe steam optimization, metro steam optimization and hydronic heating upgrades (*Tech primers*, Building Energy Exchange). It is unclear how and whether these types of resources have promoted the uptake of these technologies in buildings, however this is a useful resource the City of Toronto could develop with a local expert organisation to show possible solutions for converting water and space heating to heat pumps in buildings.

Homes

There are fewer incentive programs for single family homes, with little to none at the city level. Apart from the NYS Clean Heat Initiative, there are a few programs and tax credits available to energy efficient homes through the U.S. Department of Energy.

Workforce Development:

The City runs several trainings for building managers, with a goal to upskill almost 8000 individuals by 2025 to take on retrofit projects (City of New York, 2014). Many of these trainings are offered through the NYC Accelerator.

A lot of training options are provided at the state level. The Green Jobs - Green New York Act was passed in 2009 to use the revenue from the sales of carbon emission credits to support the training and upskilling of individuals to weatherize homes and engage in clean energy jobs, among other initiatives to work towards carbon emission reductions. NYSERDA in conjunction with the state Department of Labor are delivering many of these workforce training programs, such as the \$100 million Clean Energy Workforce Development (New York State, *Clean Energy Workforce Development*). Other programs train municipal code officials, design and energy professionals, and construction workers on how to understand and comply with the New York State Energy Code.

Copenhagen

Background:

Copenhagen's retrofitting strategy has benefited heavily from Denmark's progressive position on sustainability. Second only to Sweden on the earth.org Global Sustainability Index, Denmark is a frontrunner when it comes to sustainable development. Not only does Denmark aspire to be independent of fossil fuels by 2050, Copenhagen is aiming to become the first carbon neutral capital city in the world by 2025 (Municipality of Copenhagen, 2020).

Regulation:

Older buildings constructed prior to the year 2000 face their own regulation, intended to simplify the decision to install retrofits for existing homeowners. Copenhagen aims to improve the mandatory process of labelling them for their energy consumption level, making it easier for the city to track progress towards its target of reducing each property's energy consumption by 20-30% by 2025 through urban renewal, discussed in further detail below. In the achievement of this, the jurisdiction intends for properties such as these older buildings to progress along a series of planned energy labelling categories, and increase their own by at least two levels. Indirectly encouraging retrofits through regulatory practices like this has complemented Copenhagen's other work in incentive programs (Municipality of Copenhagen, 2020).

Finances:

In large part, Copenhagen's funding for retrofitting implementation relies on the support of their national government. The federal government of Denmark has made financial moves that have eased retrofits directly and indirectly, beginning with a tax deduction they enacted in 2016. Homeowners in all Danish jurisdictions were allowed to claim up to DKK 18,000 in tax deductions for housing improvements designed to make their homes energy-efficient or adapt to climate change, and it has since become easier for Copenhagen to sway reluctant homeowners to undertake the financial costs of retrofitting. (Teknik- og Miljøforvaltningen, 2015). Similarly, in a 2020 majority decision, the Danish government set aside DKK 30.2 billion for social housing retrofits, 18.2 billion of which was meant for projects to be initiated within a year of being earmarked. (Municipality of Copenhagen, 2020).

Starting in 2018, Copenhagen moved to develop retrofits that would help it achieve its goal of becoming carbon-neutral by 2025. At the same time that this jurisdiction moved to build envelope projects, its national government imposed capital expenditure restrictions.

When Denmark's national government lifted the expenditure restrictions for a single year in 2020, Copenhagen readjusted its retrofit implementation and found that this brief budget increase did not address all of their implementation barriers. The City implemented energy efficiency projects successfully, but did not have time for the long-term effort of training project managers

for more heavily funded large-scale retrofit projects. Accessing buildings for renovation during quarantine also proved difficult. Short-term budget increases did not address the restrictions on building access that the COVID-19 pandemic have introduced to jurisdictions worldwide, nor could they fund the retrofitting projects that Copenhagen aims to implement (*Building renovation strategy before and after COVID19: The Copenhagen case study*, n.d.).

Incentive Programs:

This jurisdiction works with cooperative and homeowner associations to incentivize urban renewal. Grants are provided to homeowners via the municipal government of Copenhagen, encouraging these private actors to implement energy retrofits in buildings that the jurisdiction cannot directly control. The urban renewal incentive program focuses on energy retrofits for homes. During 2018 to 2020, these grants were directed towards replacing private buildings' windows with more energy-efficient, noise insulating options, supporting refurbishment in more than 2000 private units over two years. Through this, Copenhagen has extended its otherwise restricted retrofitting efforts, and seeks to continue this program until 2025. Annually, Copenhagen supports about 1000 housing units in installing energy-saving retrofits through this program, expanding retrofit growth (Municipality of Copenhagen, 2020).

Workforce Development:

Through existing retrofitting efforts to certain public buildings, Copenhagen has built up a workforce equipped to further its retrofitting goals. Demonstrated through a pilot project in the city; five schools implemented envelope retrofits and refurbished their HVAC and lighting systems. Ultimately, this pilot project created 34 full-time jobs, all while preventing 1272 tonnes of carbon emissions being added to the atmosphere yearly (Dyrbøl, 2020). To expand on this effort, Copenhagen will continue its existing efforts to train operating staff in the HVAC sector. The jurisdiction will continue supporting the foundational workforce that it has thus far built up, with this initiative planned to continue through 2025 (Municipality of Copenhagen, 2020).

Recommendations

Our recommendations focus on advocacy and research-related actions that The Atmospheric Fund can undertake to support the advancement of the TransformTO strategy and retrofit initiatives across the City. We highlight specific policies and programs that TAF can leverage or better advocate for to push the retrofit agenda forward. Some of these recommendations build on pre-existing ones outlined in the ExB Strategy.

Recommendation #1: TAF should assist the City of Toronto in developing retrofit roadmaps for various building typologies and tech primers to explain prominent retrofit technologies.

A representative from the City of Toronto acknowledged that it does not provide clients with comprehensive information on the implementation of retrofits in various buildings. A detailed guide which explains the path to implement retrofits in various buildings such as a home built in the 1960s or a condominium building built last year would be beneficial. The guide can highlight the various key factors that should be considered when planning to retrofit as it is not a one size fits all approach. With TAF's expertise in implementation of various retrofits, it is well-positioned to inform and guide the City of Toronto on the development of tech primers such as the NYC Accelerator for multi-family buildings.

Recommendation #2: TAF should support the development of a 'one-stop shop' for easier access to information and support tools regarding the implementation of retrofits.

The City of Toronto provides funding support through various programs, particularly the BetterHomesTO website and the Better Buildings Navigation and Support Services page on the City's website. However, the relevant information for building owners is dispersed on various web pages which leads to a difficulty in information access. A 'one-stop shop' where building owners and other clients can access program information and financial support is beneficial and it can be modelled after the NYC Accelerator or Vancouver's CleanBC. The City of Toronto support pages can be a starting point to build this system.

Recommendation #3: TAF should assist the City of Toronto to develop more grant-based programs to support retrofit projects for low-income neighbourhoods and buildings/homes.

With rising housing costs, accessing funds for implementing retrofits can be problematic for certain individuals who reside in low-income neighbourhoods. Providing grants rather than low-interest financing options can be beneficial to increase uptake in implementing retrofits. An example can be the Heritage Energy Retrofit Grant provided by the Vancouver Heritage Foundation which offers grants up to \$10,000 for deep retrofits of designated heritage buildings.

Recommendation #4: TAF should get involved in advocacy given the current political climate.

Based on our jurisdictional scan of the three cities, we have noted that collaboration with state and national governments have been critical to the progress of the adoption of retrofits. Given the upcoming provincial election, TAF can directly advocate or support the advocacy of other initiatives:

- a. Advocating for more grant-based retrofit programs can increase uptake (based on recommendation 3)
- b. Changes to the Ontario EWRB regulation by promoting the removal of anonymity of buildings disclosing their water and energy use. This is beneficial in New

York's case as benchmarking of buildings and their Energy star ratings are publicly disclosed. This has allowed the City and other stakeholders to tailor programs and policies to aspects that require the highest need.

- c. Champion for updates to the Ontario Building Code, primarily the aspects that target major renovations within Toronto to meet the emissions targets. Advocacy can take place in the form of press releases, letters, and petitions to the Minister of Municipal Affairs and Housing.

Conclusion

The City of Toronto has been developing ambitious retrofit plans and goals to meet their greenhouse gas emissions targets. To support TAF in understanding the climate goals pertaining to retrofits, we have engaged in a jurisdictional scan of three municipalities: Vancouver, New York and Copenhagen.

Through our research and interviews, we offer key takeaways regarding each city's retrofit strategy. The City of Vancouver emphasised streamlining of information pertaining to retrofits and information for building and home owners. Furthermore, they utilised their partnerships in an effective manner as most retrofit programs were done in partnership with other organisations and the provincial government.

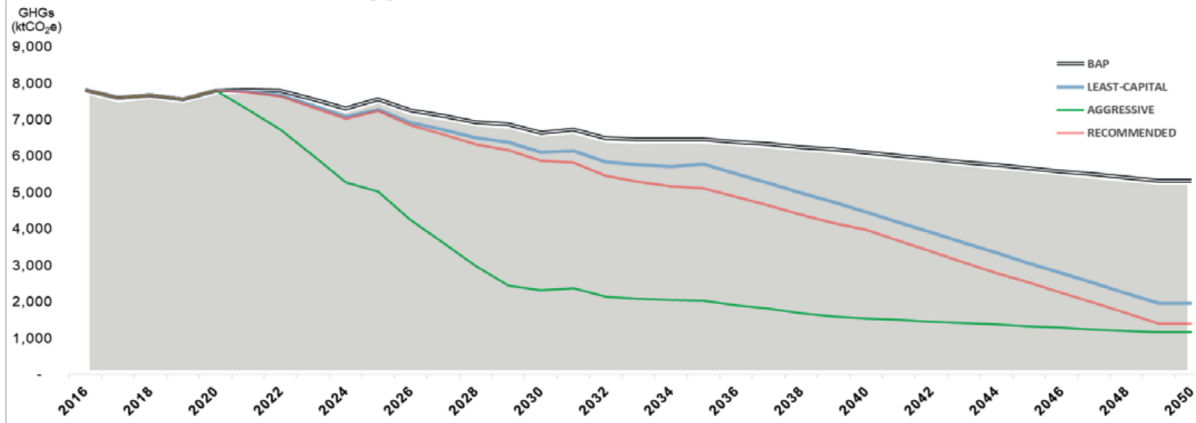
New York has demonstrated how pilot projects can lead the way for how retrofits can be carried out, measured and scaled for various buildings. Furthermore, similar to Vancouver, collaboration with the state has been vital to staying on track towards their emissions reduction and retrofit goals.

Copenhagen successfully aligned their climate goals with the national government due to similar political interests towards the reduction of carbon emissions. This political alignment provided support for greater financial investment in the funding of retrofit projects.

Appendices

Appendix A

Figure 4: GHG reductions Recommended Scenario compared to Business-as-Planned, Least Cost, and Aggressive Scenarios from 2020 to 2050



Source: [Net Zero Existing Buildings Strategy](#)

Appendix B

Table 11: Setting draft temporal targets (SFH)

Single Family Home Example						
	2025	2030	2035	2040	2045	2050
Average Performance Improvement (% emissions reductions), Recommended scenario (See Figure 18)	6%	17%	33%	50%	69%	90%
Draft GHGI Target (kg/m²)	42	32	24	18	10	4

Table 12: Setting draft time of sale/permit triggers (small commercial)

Small Commercial Example						
	2025	2030	2035	2040	2045	2050
Average Performance, Recommended (from Figure 13, red line / RHS axis)	7%	17%	26%	38%	51%	64%
Min Package Reduction at Permit Trigger	45%	45%	45%	62%	62%	62%
Cluster 10 (Office) GHGI (kg/m²)	27	27	27	19	19	19
Avg Package Reduction, Permit/Sale Trigger	59%	59%	59%	64%	65%	65%

Source: [Net Zero Existing Buildings Strategy](#) (March 2021)

Appendix C

Available Rebates

Refer to the individual rebate pages for eligibility and application details.

Category	Upgrade	Rebates	Municipal Top-Ups
Heat Pumps	Ductless Mini-Split Heat Pump	up to \$6,000	Yes
	Ductless Multi-Split Heat Pump	up to \$6,000	Yes
	Tier 1 Central Ducted Heat Pump	\$1,200	No
	Tier 2 Central Ducted Heat Pump	up to \$6,000	Yes
	Dual Fuel Ducted Heat Pump	\$3,000	Yes
	Air-to-Water Heat Pump	\$3,000	Yes
	Combined Space and Hot Water Heat Pump	up to \$4,300	Yes
	Electrical Service Upgrade	\$500	Yes

Natural Gas Furnaces and Boilers	Natural Gas Furnace	up to \$1,000	No
	Natural Gas Boiler	\$1,000	No
	Natural Gas Combination Heating and Hot Water System	\$1,500	No
Water Heating	Natural Gas Water Heater	up to \$1,000	No
	Electric Heat Pump Water Heater	\$1,000	Yes
Secondary Space Heating	Natural Gas Fireplace	\$300	No
Building Envelope	Insulation	up to \$5,500	No
	Windows and Doors	up to \$2,000	No

Source: [CleanBC Better Homes and Home Renovation Rebate Program](#)

Appendix D

New legislated GHG caps for buildings in New York City

Occupancy Group	Building Emissions Limits 2022-2023	Building Emissions Limits 2024-2029
Assembly (A) Education (E) High-Hazard (H) Utility & Misc. (U)	0.008886 ton CO ₂ e/sf	0.004439 ton CO ₂ e/sf
Business (B) Institutional (I) Mercantile (M)	0.008552 ton CO ₂ e/sf	0.004850 ton CO ₂ e/sf
Factory (F) Storage (S)	0.005170 ton CO ₂ e/sf	0.001374 ton CO ₂ e/sf
Residential (R)	0.007010 ton CO ₂ e/sf	0.004339 ton CO ₂ e/sf

Source:

<https://be-exchange.org/insight/analysis-nyc-proposes-building-emissions-limits-to-meet-80x50/>

Appendix E

RetrofitNY

NYSERDA launched RetrofitNY to help meet retrofit goals across the state (New York State, *RetrofitNY*). The initiative, inspired by Netherland's Energiesprong, is designed to help make a large number of affordable housing units (they did not state how many exactly) carbon neutral by 2025. NYSERDA is pouring \$30 million into RetrofitNY projects between 2015-2025 (Humphries, 2016). Still in the proof of design phase, they are piloting many rounds of retrofit projects across the state, including New York City. In the first round, six design-build teams were awarded to design a carbon neutral multi-family affordable unit. One of the pilot teams worked on retrofit designs to nine ordinary apartment buildings owned by RiseBoro in Brooklyn, with 1.8 million in financing from NYSERDA. When these nine buildings are fully renovated, they will meet a strict passive house standard, reducing energy costs by 80 percent, or \$180,000/year (Sisson, 2020). They are also working on replacing old HVAC systems with air source heat pumps, with a lot of the infrastructure being on the exterior of the building. This allows them to make the changes without temporarily or permanently displacing tenants (YCC Team, 2021).

Through the first pilot stage, RetrofitNY learned that they needed to tackle adoption factors related to the lack of available technologies in the U.S. market, the high costs of building materials and difficulty in engaging manufacturers to build retrofit solutions, and the need to streamline design and construction processes.

RetrofitNY announced a second round of funding of \$5 million for electric deep energy retrofit pilot projects for the affordable housing sector. This includes \$100,000 for the design and up to \$40,000 for construction per dwelling unit.

The team at RetrofitNY is also working with industry stakeholders to streamline processes to reduce costs for these retrofit plans, with the aim to scale pilot plans to more buildings in the near future. RetrofitNY also launched a pledge program as a formal call to action to incentivize manufacturers to offer more building retrofit solutions by using the collective buying power of building owners to bring more solutions to the market (New York State, *RetrofitNY Pledge*). So far, there are 39 signatories, representing roughly 9,500 multifamily buildings in the city out of a potential 705,000.

Overall, with the support of NYSERDA, New York City has had an excellent start to their retrofitting efforts. What the City has done particularly well is focus on retrofitting buildings that feature affordable units (Toronto is doing similar: 1,500 of the 3,000 homes are social housing) without placing the burden on tenants (YCC Team, 2021). New York City still being in the pilot

stages of their retrofit is an indication of the journey that we can expect TransformTO's path to take. Such a large undertaking will always take a long time, but NYSERDA expects that once these initial pilot programs are completed and provide them with good empirical data, they can begin the accelerating retrofits to help them reach their 2030 interim goal as well as the 2050 goal.

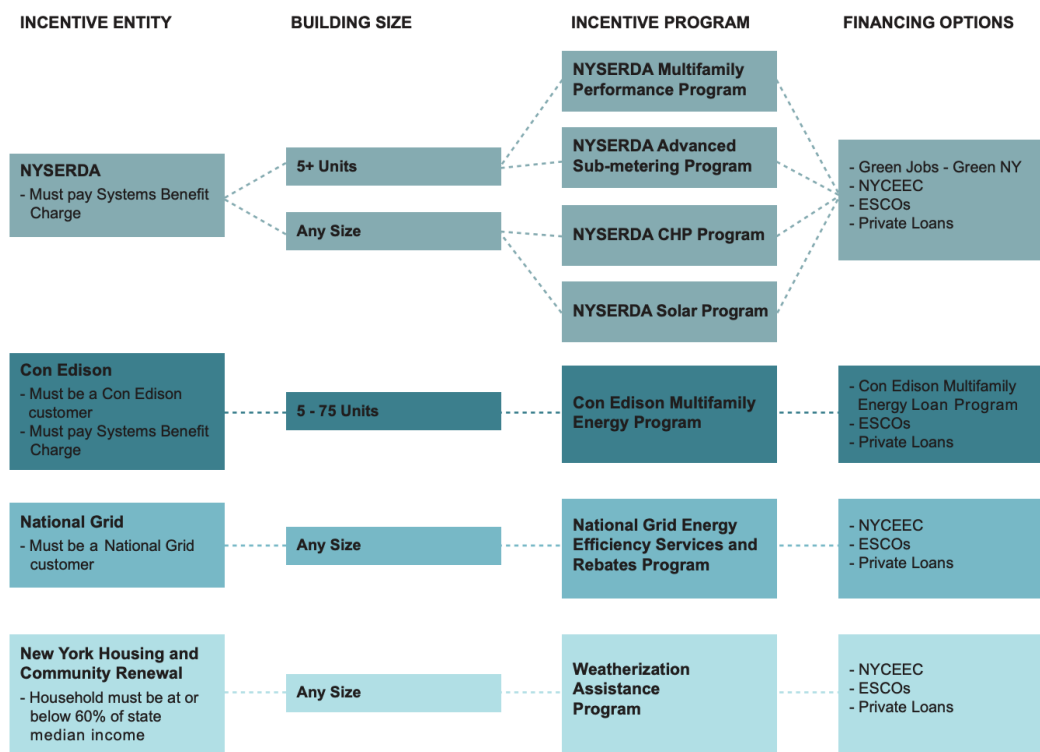
Other retrofit pilots:

New York City has chosen nine city facilities where they are working to reduce energy usage by 50% as pilots for this project, with a further 28 to be chosen for future retrofit audits. As with other retrofits, these nine initial buildings will go beyond examining HVAC and lighting systems, and consider design features, windows, and rooftops. Among the buildings being targeted for audits are a city parking garage, the DCLA Brooklyn Museum, and a school (Plautz, 2019).

Perhaps the most visible retrofitting project in New York City has been the Empire State Building. Between 2010 and 2020, the skyscraper cut carbon emissions from operations by 40%, and owners plan to slash another 40% over the next decade (Kaplan & Steckleberg, 2020). The deep retrofit cost \$31 million and today saves the Building \$4 million/year in electric bills, making it an extremely successful endeavour. The trust that owns the Empire State Building hopes to be able to use it as a model of sustainability. The city and the trust posit that if they can conduct such aggressive deep energy retrofits to the Empire State Building, then they can work anywhere.

Appendix F

Multifamily Financing and Incentive Options in New York City



Source: New York City Mayor's Office of Long-Term Planning and Sustainability

Source: [One City Built to Last](#)

Appendix G

Table 1 - Summary of New York City's emissions/energy goals, progress to date and key adoption factors

Relevant Goal	Progress to date	Key Adoption Factors
Reduce city-wide emissions by 80% from 2005 levels by 2050 1) Interim goals of 26% by 2020, 30% by 2025, and 40% by 2030 (see appendix) 2) Reduce emissions by 3.4 million metric tons between 2015-2025 for	1) On track - city-wide emissions from stationary energy (residential, commercial, construction, fugitive) reduced from 45,637,924 metric tons in 2005 to 34,024,403 metrics tons in 2020 (33% reduction) 2) On track - Between 2015 and 2025, emissions from	COVID-19: pandemic restrictions have limited activity in the city but also hindered retrofit activities Regulation: Local Law 97 introduces a gradual approach to GHG penalties (2024-2029, 2030-2034, and 2035 and later) for large buildings

buildings	stationary energy reduced from 38,084,598 to 34,024,403 metric tons (a difference of 4.06 million metrics) (See Appendix B for data table calculations of these figures)	(over 25,000 sqft.) who do not meet city emissions goals. This applies to 50,000 buildings currently. (see Appendix B for GHG caps) - Regulation: NYC benchmarking law (Local Law 133) requires buildings over 25,000 sqft to submit annual energy and water consumption data, which supports transparency and greater accountability
Accelerate retrofits in up to 1,000 properties per year between 2015 and 2025 (40% being social housing, 60% being multifamily buildings) - Equivalent to 940,000 GHG metric tons reduction - Equivalent to more than 20,000 buildings/400,000 residential units (Note, there are roughly 727,000 buildings in NYC, most of which comprise low-rise buildings and homes)	An aggregated number cannot be found online. 584 retrofit projects have been recorded by the Open Data portal of the City Based on a 2019 report using 2017 data, roughly 5,000 privately-owned buildings have been assisted by the Retrofit Accelerator and Community Retrofit NYC programs since 2015. 9400 buildings across New York state have pledged through RetrofitNY to install cost effective carbon neutral retrofit solutions to hit 2030 and 2050 emissions reductions goals.	- Program: Retrofit Accelerator Program was started in 2012 by the City to provide free, individualized support for building decisionmakers to cut operating costs, meet local law compliance, access financing and boost building performance - Program: RetrofitNY is a state-led program designed to help make a large number of affordable housing units (they did not state how many exactly) carbon neutral by 2025. - Finances: RetrofitNY is financed through for profit and non-profit corporations such as the Community Preservation Corporation. - Incentives: Several financing/incentive programs (see Appendix B), includes PACE under

		Local Law 96 of 2019.
Phase out 1) No. 6 heavy heating fuel oil by 2015 and 2) No. 4 fuel oil by 2030 across all sectors (not just buildings)	1) Delayed completion - No. 6 fuel oil was phased out by 2019 (based on GHG emissions recorded) 2) On track - No. 4 fuel oil emissions reduced from 1,260,000 metric tons in 2015 to 495,820 metrics tons in 2020 Natural gas emissions have remained steady between 2015 and 2020, at 16 and 17 million metrics tons	- Regulation: The City implemented laws to phase out No. 6 and No. 4 fuel oils - Programs: NYC Clean Heat Program which ran until 2015 helped accelerate the conversion of fuel oil in buildings to cleaner fuels and worked with industry partners to reduce the costs of heat pumps. This helped achieve phasing out of No. 6 fuel oil.
Upskill 7,725 individuals by 2025 to take on retrofit projects, create 3,475 new jobs in construction	Unsure - Cannot find data	- Programs: several trainings offered through the Retrofit Accelerator and nonprofits - Programs: Green Jobs, Green New York Program

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